Exploring and Analyzing Climate Variations Online by Using NASA MERRA-2 Data at GES DISC

Giovanni Makes Earth Science Learning Interactive and Easier

Suhung Shen[1,2] , Dana M. Ostrenga[1,3], Bruce E. Vollmer[1], Steven J. Kempler[1]

suhung.shen@nasa.gov [1]NASA Goddard Space Flight Center, [2]George Mason University, [3]ADNET

Abstract

NASA Giovanni (Geospatial Interactive Online Visualization ANd aNalysis Infrastructure) is a Web-based data visualization and analysis system developed by the Goddard Earth Sciences Data and Information Services Center (GES DISC). Current data analysis functions for a single variable include **Lat-Lon map, time series, scatter plot, correlation map, difference, cross-section, vertical profile, and animation**. The system enables basic statistical analysis and comparisons of multiple variables. This Web-based tool facilitates **data discovery, exploration, and analysis** of over a thousand global and regional remote sensing and model data sets from multiple NASA data centers. Long-term global assimilated atmospheric, land, and ocean data have been integrated into the system, enabling quick exploration and analysis of climate data without downloading or preprocessing. Example data include climate reanalysis data from NASA Modern-Era Retrospective-analysis for Research and Applications, Version 2 (**MERRA-2**) beginning in 1980 to present; land data from NASA Global Land Data Assimilation System (**GLDAS**) covering 1948 to 2012; and ocean biological data from NASA Ocean Biogeochemical Model (**NOBM**) covering 1998 to 2012. This presentation, using surface air temperature, precipitation, ozone, and aerosol from MERRA-2, demonstrates climate variation analysis with Giovanni for selected regions.

## Giovanni

http://giovanni.gsfc.nasa.gov/giovanni/
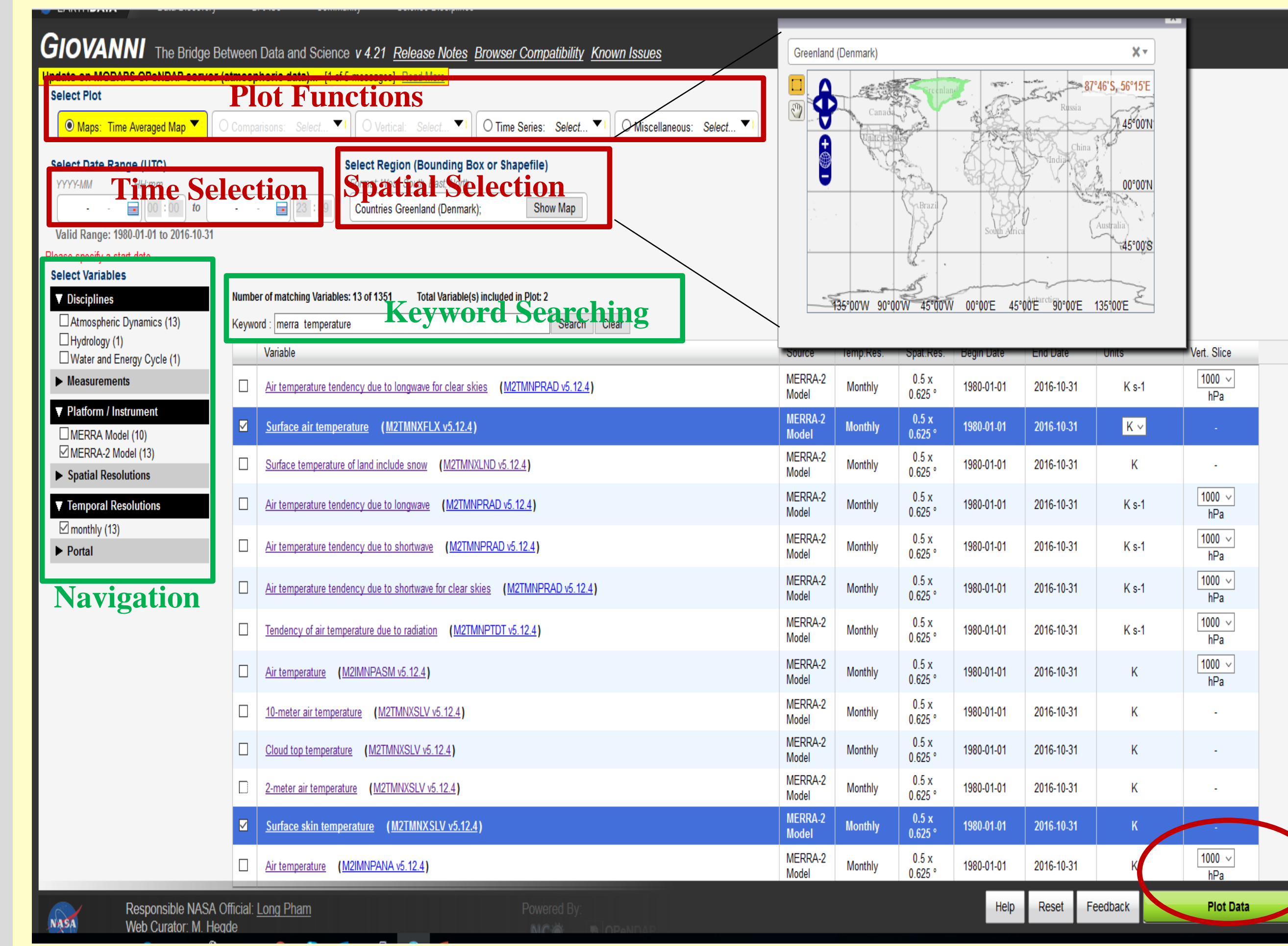
About MERRA-2 Products

MERRA-2 is a NASA reanalysis for the satellite era focuses on historical analyses of meteorology, atmospheric chemistry, land, ocean, and aerosols data on a broad range of weather and climate time scales and places the NASA Earth Observation System (EOS) suite of observations along with GPS-Radio Occultation datasets in a climate context.

- ➤ **Model:** NASA GMAO-5
- ➤ **Temporal Coverage:** 1980-present
- ➤ **Temporal Resolution:** hourly, 3-hourly, monthly, monthly diurnal
- ➤ **Spatial Coverage:** Global
- ➤ **Spatial Resolution:** 0.5º x 0.625º
- ➤ **Data Format:** NetCDF-4
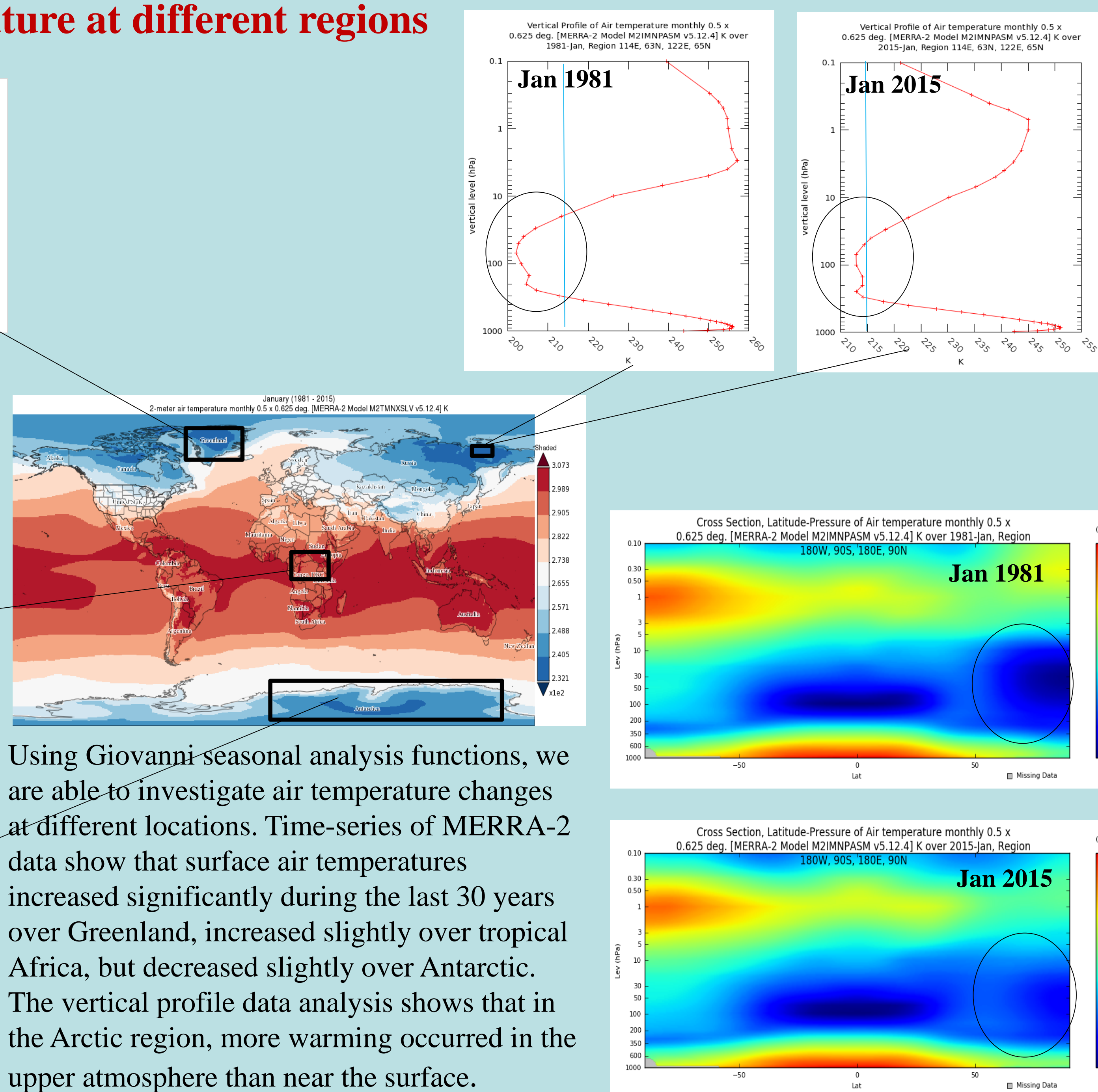
Finding and Downloading Data: UUI
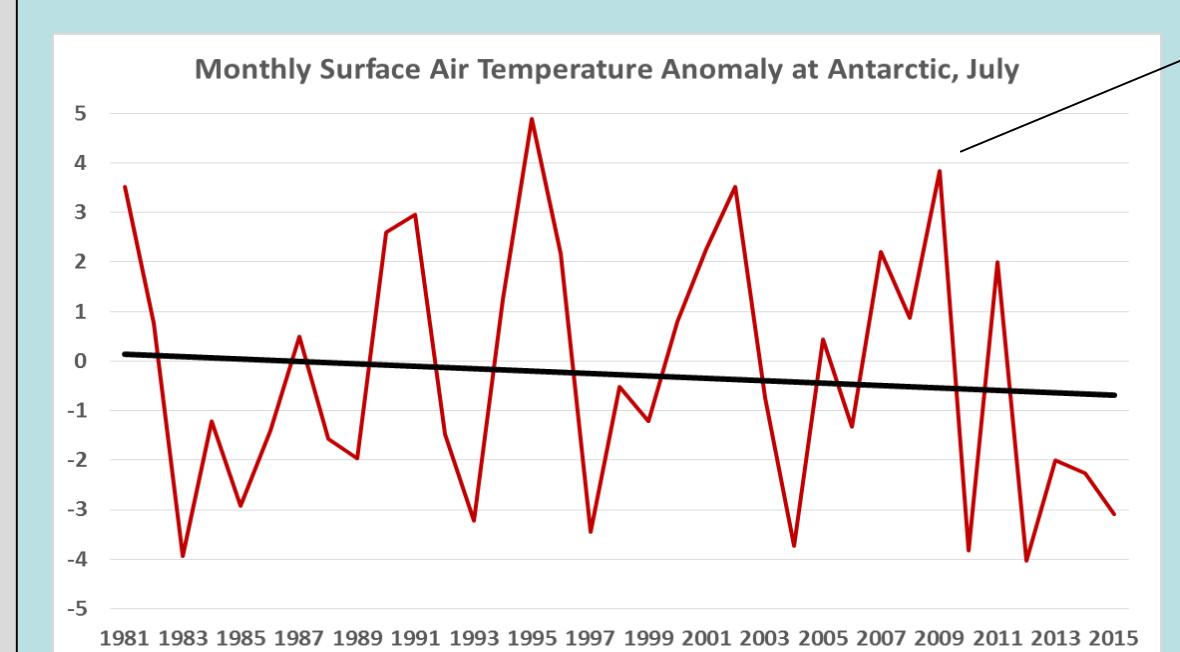
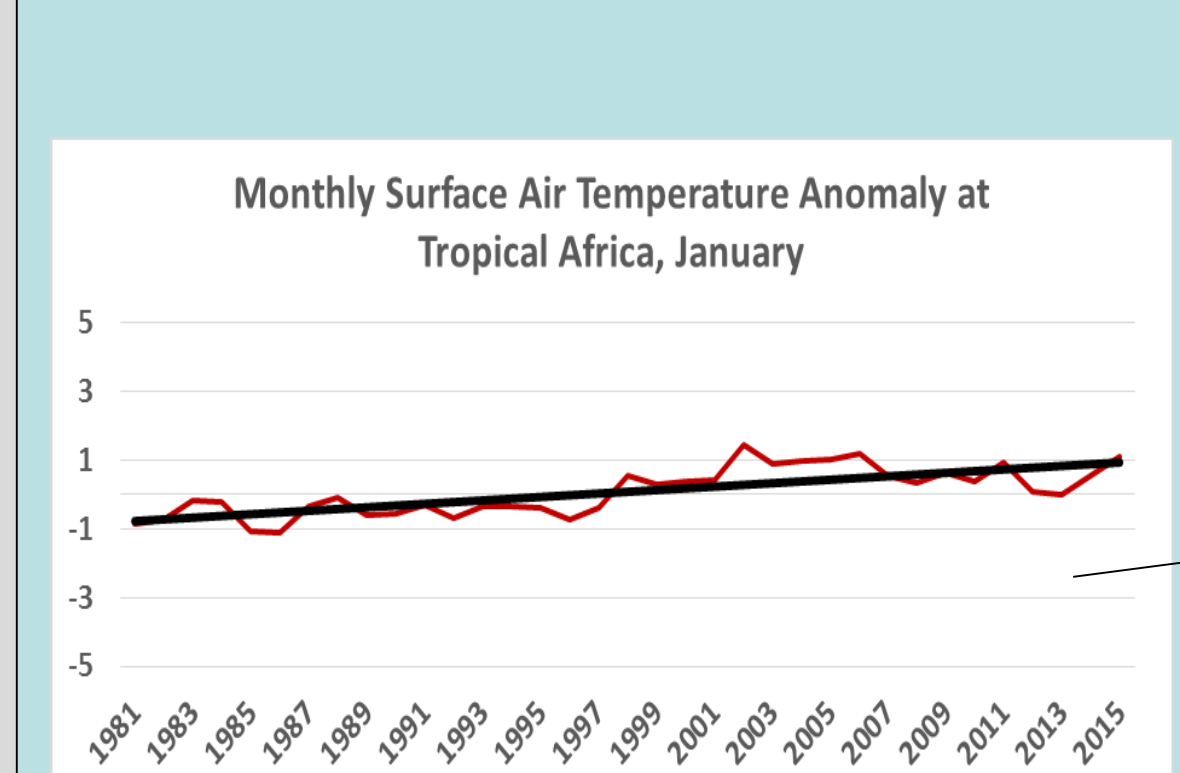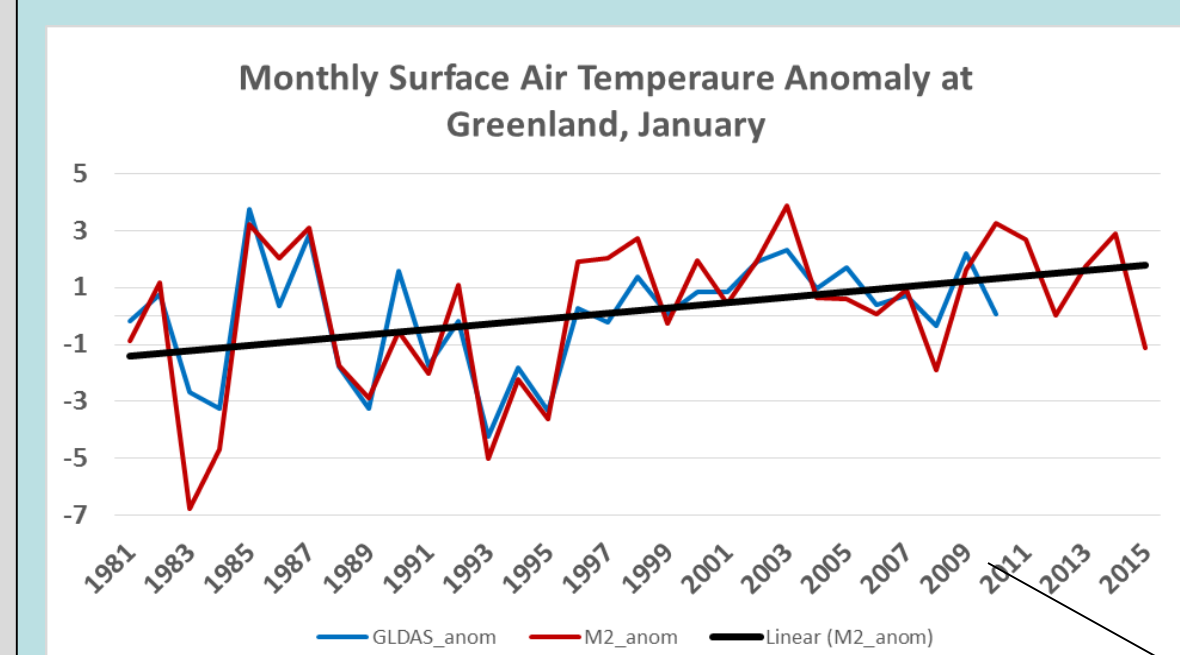http://disc.gsfc.nasa.gov/uui/datasets?keywords=%22MERRA-2%22
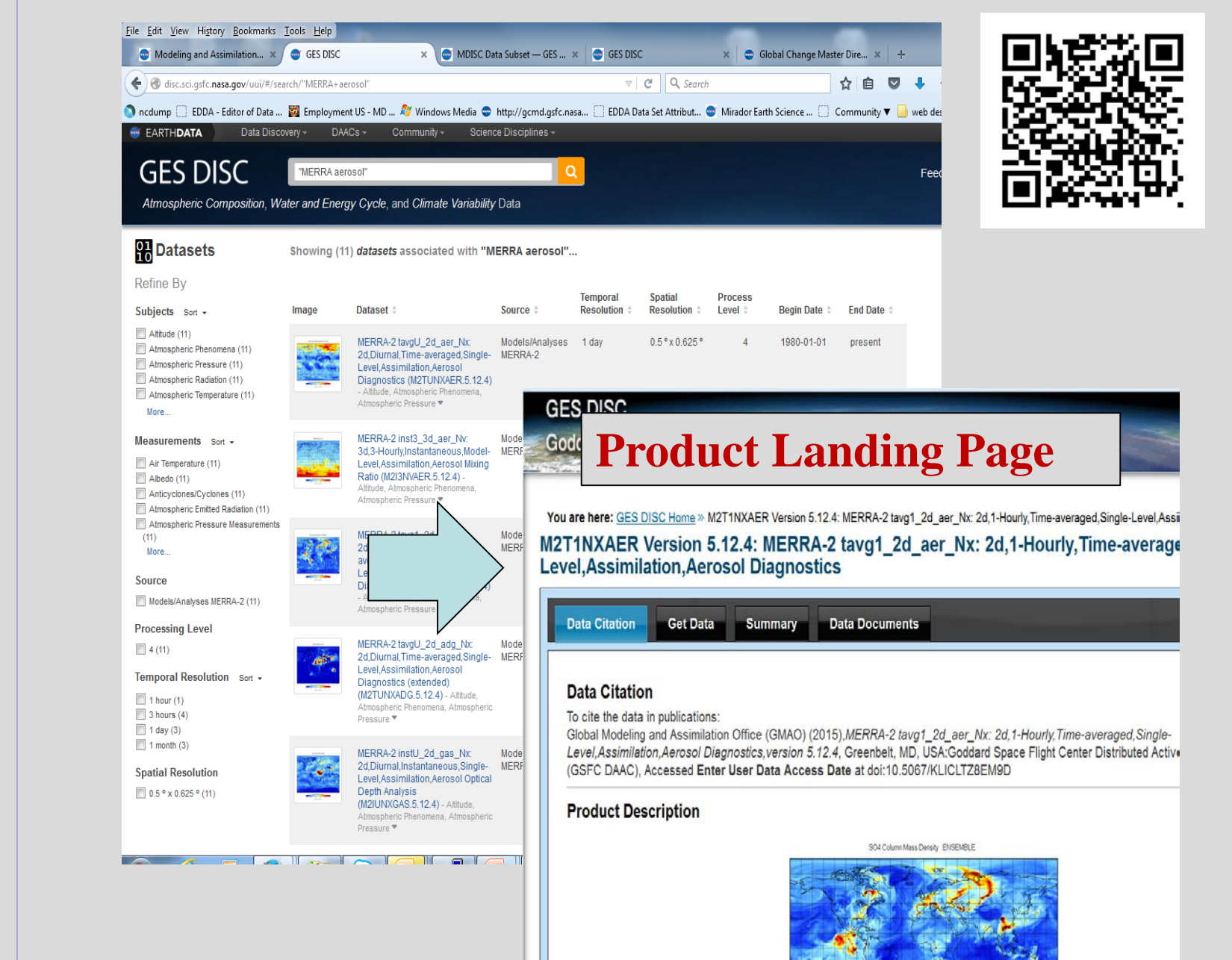

Other Data Services:
- ✓ MERRA-2 subsetter
- ✓ Direct download (HTTPS)
- ✓ OPeNDAP
- ✓ GDS
- ✓ NASA centralized Earth Data search system
- ✓ Data Recipes (step-by-step instructions on access, read, and view data with various data tools)

## Variations of air temperature at different regions

Using Giovanni seasonal analysis functions, we are able to investigate air temperature changes at different locations. Time-series of MERRA-2 data show that surface air temperatures increased significantly during the last 30 years over Greenland, increased slightly over tropical Africa, but decreased slightly over Antarctic. The vertical profile data analysis shows that in the Arctic region, more warming occurred in the upper atmosphere than near the surface.

Ozone depletion
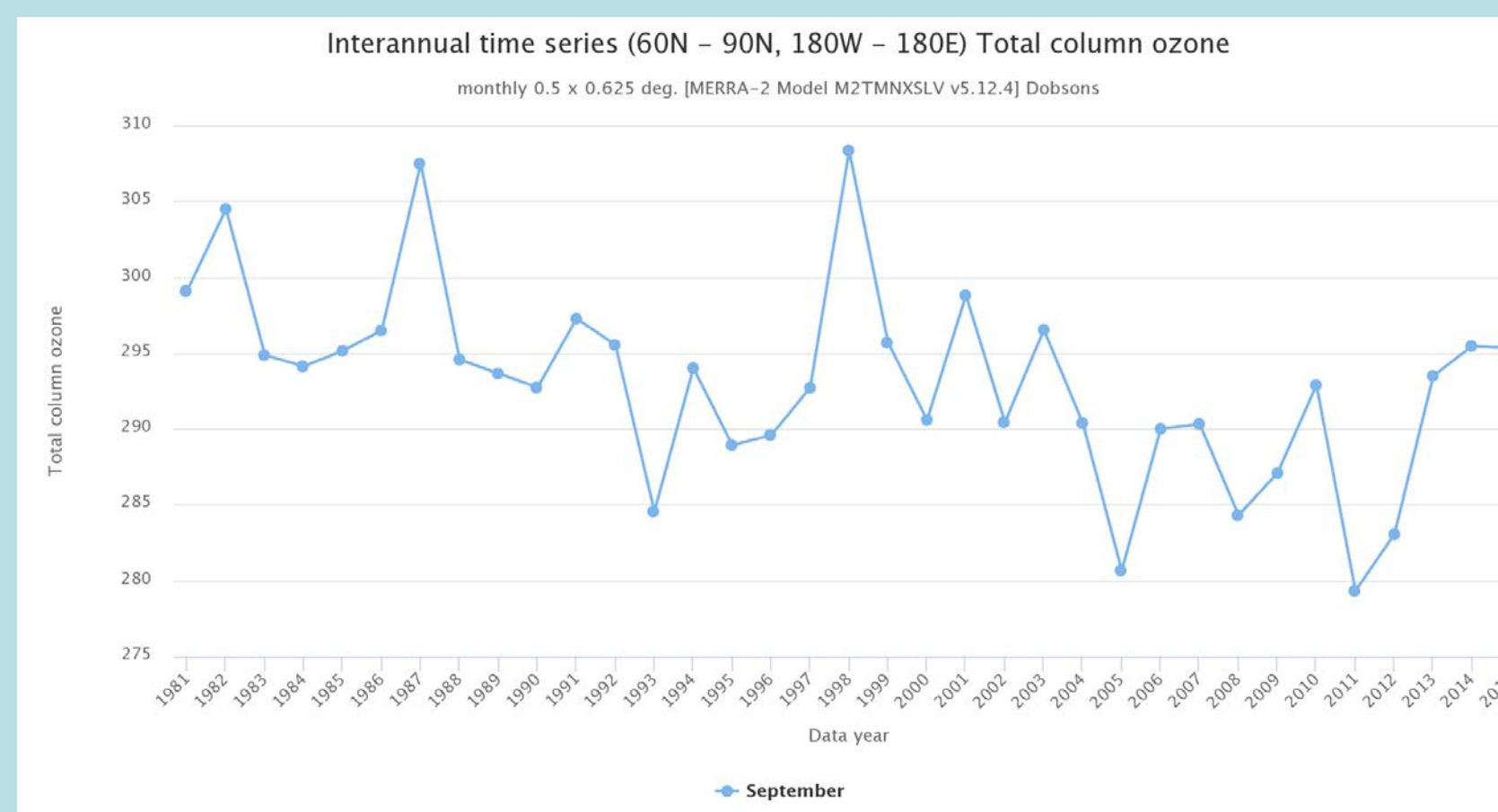
Total Ozone time series of September (left) shows a significant decrease from 1981 to 2015. The images above are five-year averages of Northern Hemisphere total ozone for 1981-1985 (center) and 2011-2015 (right), respectively. The images were saved as KMZ from Giovanni for display in GoogleEarth.
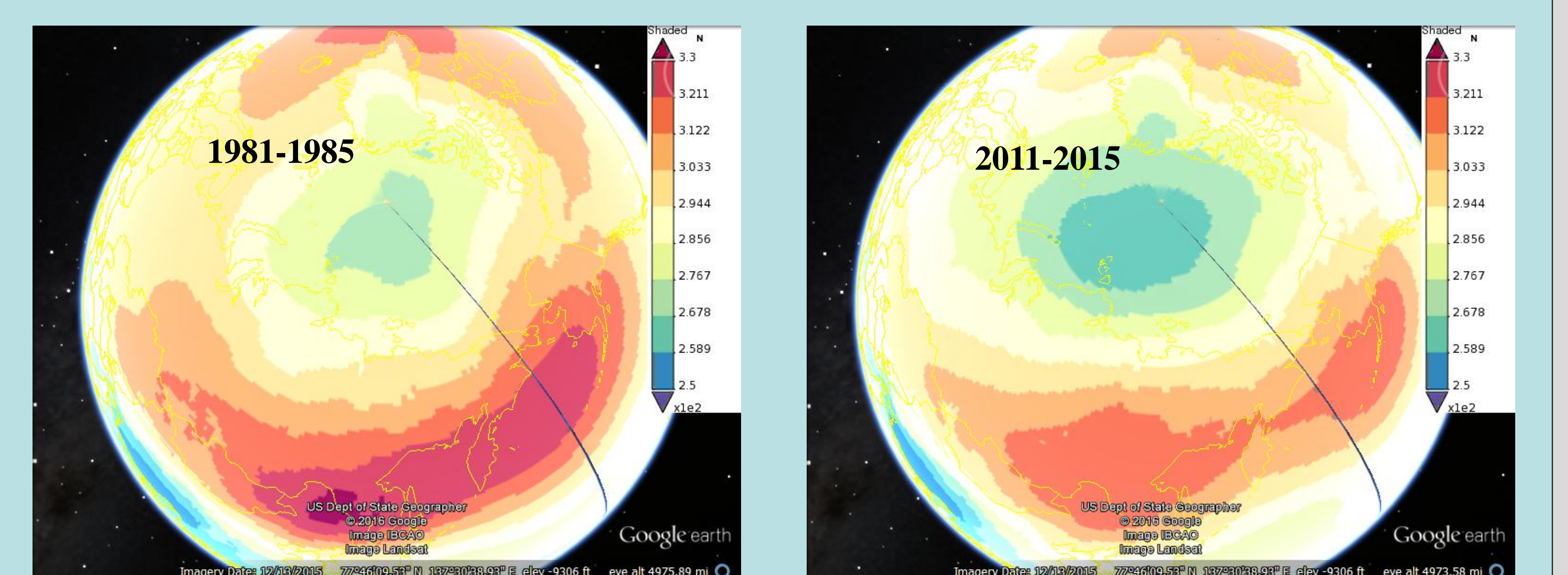
Large-scale relationship between monthly aerosol optical depth and precipitation
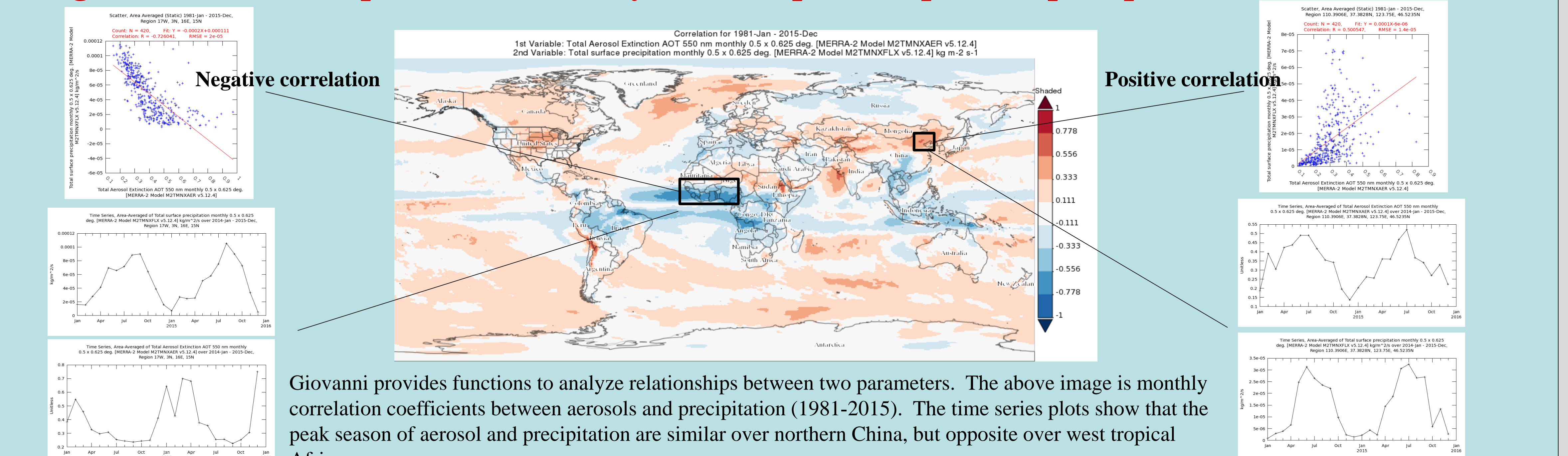
Giovanni provides functions to analyze relationships between two parameters. The above image is monthly correlation coefficients between aerosols and precipitation (1981-2015). The time series plots show that the peak season of aerosol and precipitation are similar over northern China, but opposite over west tropical Africa.

References:

Bosilovich, M. G., R. Lucchesi, and M. Suarez, 2015. **MERRA-2: File Specification**. *GMAO Office Note No. 9*, http://gmao.gsfc.nasa.gov/pubs/docs/Bosilovich785.pdf